REMARKS

In paragraph 1 of the Office Action it is indicated that all relevant drawing objections are withdrawn as being satisfied by Applicant's reply filed 04/04/2005. Applicant appreciates the Examiner's withdrawal of the drawing objections.

In paragraph 2 of the Office Action claims 23-26, 30, 36-39 and 43 are rejected under 35 U.S.C. 103(a) as being anticipated by Gill (hereinafter Gill '616) (US 6,674,616 B2) in view of Shukh et al. (hereinafter Shukh) (US 6,667,616 B1), stating:

> "Regarding claims 23 and 36, Gill '616 discloses a hard disk drive [30 Figs. 1-3], including at least one magnetic head [col. 5, lines 30-34; Fig. 6] including a spin valve sensor, having a read head [72] portion comprising:
>
> a magnetic shield layer (S1) [80] being fabricated above a substrate base;
>
> a first electrical insulation layer (G1) [76] being fabricated above said Si layer;
>
> a spin valve sensor structure [74] being disposed above said G1 layer [76];
>
> wherein said spin valve sensor structure [74] includes a seed layer [218,2201 being fabricated above said G1 layer [74] a PtMn layer [212] being disposed above said seed layer [218,220] and at least one pinned magnetic layer [204] and at least one free magnetic layer [202] being disposed above said PtMn layer [74] and
>
> wherein said seed layer [218,220] has an upper surface comprised of NiFeCr [270]
>
> Gill '616 does not disclose a rough top crystallographic surface that is rougher than a top crystallographic surface of a deposited NiFeCr seed layer.
>
> Shukh teaches a seed layer [74] made of Ta, NiFeCr, Ru or CrV, which has a purpose to optimize a texture, grain size, and morphology of the subsequent layers. Shukh further teaches it is desirable to have a certain degree of roughness at the interface between ferromagnetic magnetic layer [80] and spacer [78] and between ferromagnetic layer [76] and spacer [78] (col. 4, lines 15-23).
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the NiFeCr seed layer of Gill '616 with a rough crystallographic surface as taught by Shukh.
>
> The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the NiFeCr seed layer of Gill '616 with a rough crystallographic surface as taught by Shukh in order to facilitate transfer of electrons to subsequent layers where spin dependent scattering occurs (Shukh, col. 4, lines 25-26).

> • Regarding claims 24-26 and 37-39, Gill '616 discloses the NiFeCr layer is formed with a thickness of approximately 20 Å [col. 7, lines 47-50; Fig. 10], which encompasses the claimed range.
>
> • Regarding claims 30 and 43, Gill '616 teaches a spin valve sensor structure [74] includes at least one PtMn antiferromagnetic layer [212] at least one pinned magnetic layer [204] having a composition which includes CoFe, at least one spacer layer [200] having a composition which includes Cu, and at least free magnetic layer [202] having a composition which includes NiFe [Fig. 10].

Applicant respectfully traverses this ground of rejection and asserts that Shukh neither teaches nor renders obvious a seed layer having a rough crystallographic top surface "that is rougher than a top crystallographic surface of a deposited NiFeCr seed layer" as recited in Applicant's previously amended claims.

With particular regard to independent claims 23 and 36, each recites the limitation of an NiFeCr seed layer that has a rough crystallographic top surface "that is rougher than a top crystallographic surface of a deposited NiFeCr seed layer." This limitation was added to these claims in response to the prior Office Action. In this Final Office Action the newly added teachings of Shukh are relied upon, stating:

> "Gill '616 does not disclose a rough top crystallographic surface that is rougher than a top crystallographic surface of a deposited NiFeCr seed layer.
>
> Shukh teaches a seed layer [74] made of Ta, NiFeCr, Ru or CrV, which has a purpose to optimize a texture, grain size, and morphology of the subsequent layers. Shukh further teaches it is desirable to have a certain degree of roughness at the interface between ferromagnetic magnetic layer [80] and spacer [78] and between ferromagnetic layer [76] and spacer [78] (col. 4, lines 15-23). Emphasis added.
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the NiFeCr seed layer of Gill '616 with a rough crystallographic surface as taught by Shukh.
>
> The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the NiFeCr seed layer of Gill '616 with a rough crystallographic surface as taught by Shukh in order to facilitate transfer of electrons to subsequent layers where spin dependent scattering occurs (Shukh, col. 4, lines 25-26)."

Applicant asserts that the above interpretation of Shukh is overbroad, and that Shukh does not teach an NiFeCr seed layer having a top surface that is "rougher than a top crystallographic surface of a deposited NiFeCr seed layer." Specifically, Shukh, col. 4, lines 15-39 teaches a seed

layer which is a deposited seed layer, as is next quoted.

> "Seed layer 74 is deposited prior to deposition of free layer 76. Seed layer 74 is preferably made of Ta, NiFeCr, Ru or CrV. Seed layer 74 preferably has a high resistivity to minimize a shunting effect. The purpose of seed layer 74 is to optimize a texture, grain size and morphology of the subsequent layers. For example, it is desirable to have a certain degree of roughness at the interface between ferromagnetic layer 80 and spacer 78, and between ferromagnetic layer 76 and spacer 78. The roughness facilitates transfer of electrons from spacer 78 to the ferromagnetic layers 76 and 80, where spin-dependent scattering occurs. However, the interfaces can not be made too rough or the GMR effect is lost. The morphology is critical in obtaining a large GMR effect since it permits the use of very thin free layer 76 and non-magnetic spacer 78." Emphasis added.

As can be seen, Shukh specifically teaches a deposited seed layer. It does not teach a seed layer having a rough top surface, nor particularly, one that is rougher than a top crystallographic surface of a deposited NiFeCr seed layer, as claimed. Indeed, Shukh does not even mention the properties of the top surface of the seed layer. Rather, as quoted above, Shukh teaches the desirability of a certain degree of roughness at the interface between ferromagnetic layer 80 and spacer 78, and between ferromagnetic layer 76 and spacer 78. And, while Shukh states that it is the purpose of seed layer 74 to optimize a texture, grain size and morphology of subsequent layers, Shukh fails to even mention the roughness of the top surface of the seed layer in this regard.

In fact, Shukh teaches away from the present invention in that Shukh teaches the use of a seed layer top surface of a deposited seed layer, whereas the present invention, as claimed, teaches the use of a seed layer surface that is rougher than that of a deposited seed layer. The use of a deposited seed layer is the prior art over which the present invention is an improvement. The aspects, limitations and advantages of Applicant's invention therefore cannot be achieved through the teachings of Shukh with its deposited seed layer. No other cited prior art teaches anything in this regard which would suggest to one skilled in the art that something other than a deposited seed layer can be advantageously utilized; particularly, a seed layer having a top surface that is rougher than the top surface of a deposited seed layer. Applicant therefore respectfully submits that independent claims 23 and 36 recite limitations that are neither taught by nor obvious from the cited prior art.

Regarding the remaining rejected dependent claims 24-26, 30, 37-39 and 43, Applicant respectfully submits that these claims are allowable in that they depend from an allowable base claim either directly or indirectly.

In paragraph 3 of the Office Action claims 1-3, 18, 19, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (hereinafter Gill '014) (US 6,430,014 B1) in view of Gill (hereinafter Gill '616) (US 6,674,616 B2) and further in view of Shukh et al. (hereinafter Shukh) (US 6,667,616 B1), stating:

> Regarding claims 1, 2, 18, 19, 31 and 32, Gill '014 discloses a hard disk drive [30; Figs. 1-3], including at least one magnetic head [col. 5, lines 46-49; Figs. 6 and 11] including a spin valve sensor [130] having a read head [72] portion comprising:
>
> a magnetic shield layer (S1) [152] being fabricated above a substrate base;
>
> a first electrical insulation layer (G1) [148] being fabricated above said Si layer;
>
> a spin valve sensor structure [200] being disposed above said G1 layer [148];
>
> wherein said spin valve sensor structure [200] includes a seed layer [228, 230, 232] being fabricated above said G1 layer [148], a PtMn layer [214] being disposed above said seed layer [228, 230, 232] and at least one pinned magnetic layer [204] and at least one free magnetic layer [206] being disposed above said PtMn layer [214]; and
>
> wherein said seed layer includes an Al_2O_3 layer [228], and NiMnO layer [230] and a Ta layer [232] [Fig. 12].
>
> Gill '014 does not disclose a seed layer including a NiFeCr layer but teaches other seed layer materials may be desired [col. 9, lines 40-41].
>
> Gill '616 teaches a seed layer, with a thickness of 20 Å, to include Ta or NiFeCr [col. 7, lines 47-50; Fig. 10].
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the Ta layer of Gill '014 with a NiFeCr layer as taught by Gill '616.
>
> The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to substitute the Ta layer of Gill '014 with a NiFeCr layer as taught by Gill '616 because they are known seed layer materials that are used in spin valves and using them is merely a substitution of art recognized equivalents.
>
> Furthermore, neither Gill '014 or Gill '616 teach the NiFeCr layer has a rough top crystallographic surface that is rougher than a top crystallographic surface of a deposited NiFeCr seed layer.

> Shukh teaches a seed layer [74] made of Ta, NiFeCr, Ru or CrV, which has a purpose to optimize a texture, grain size, and morphology of the subsequent layers. Shukh further teaches it is desirable to have a certain degree of roughness at the interface between ferromagnetic magnetic layer [76] and spacer [78] and between ferromagnetic layer [76] and spacer [78](col. 4, lines 15-23).
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the NiFeCr seed layer of Gill '014 and Gill '616 with a rough crystallographic surface as taught by Shukh.
>
> The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the NiFeCr seed layer of Gill '014 and Gill '616 with a rough crystallographic surface as taught by Shukh in order to facilitate transfer of electrons to subsequent layers where spin dependent scattering occurs (Shukh, col. 4, lines 25-26).
>
> Regarding claim 3, Gill '014 teaches a spin valve sensor structure [200] includes at least one PtMn antiferromagnetic layer [214] at least one pinned magnetic layer [202] having a composition which includes CoFe, at least one spacer layer [206] having a composition which includes Cu, and at least free magnetic layer [206] having a composition which includes NiFe [Fig. 12]."

Regarding independent claims 1, 18 and 31, as argued above with regard to independent claims 23 and 36, the limitation that distinguishes the prior art, (that the NiFeCr seed layer has a rough crystallographic top surface which is rougher than the crystallographic surface of a deposited NiFeCr seed layer), is not taught by nor obvious from the cited prior art. Specifically, the cited prior art teaches the deposition of seed layers upon which sensor layers are disposed. There is no teaching within the prior art regarding the nature of the top crystallographic surface of the seed layer, other than that the crystallographic surface of the seed layers is that of a deposited seed layer. Applicant therefore respectfully submits that independent claims 1, 18 and 31, as previously amended, are neither taught by nor obvious from the cited prior art.

With regard to claim 2, Applicant has been previously amended it to include the limitation that the rough top surface is formed by etching a previously deposited NiFeCr top surface. As this is a further method step in a method claim, Applicant submits that the prior art fails to teach or render obvious this step. Whereby previously amended claim 2 is also allowable.

With regard to dependent claims 3, 19 and 32, Applicant respectfully submits that these claims are allowable in that they depend from an allowable base claim.

In paragraph 4 of the Office Action claims 4-6, 20-22 and 33-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (hereinafter Gill '014) (US 6,430,014 Bi), Gill (hereinafter Gill '616) (US 6,674,616 B2) and Shukh et al. (hereinafter Shukh) (US 6,667,616 Bi) as applied to claims 1, 18 and 31 above, and further in view of Mao et al. (hereinafter Mao) (US 6,490,140 Bi), stating:

> "Regarding claims 4-6, 20-22 and 33-35, Gill '014, Gill '616 and Shukh disclose all the features, supra, but do not show the composition of the NiFeCr layer as $Ni_{49.5}$ $Fe_{12.5}$ Cr_{38}.
>
> Mao teaches the composition of seed layer [12] is preferably in the range of Ni_{60} Fe_{15} Gr_{38} to about Ni_{48} Fe_{12} Cr_{40} [col. 4, lines 30-37], which encompasses the claimed range.
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to manufacture the NiFeCr layer of Gill '014, Gill '616 and Shukh with a NiFeCr composition as taught by Mao.
>
> The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to manufacture the NiFeCr layer of Gill '014, Gill '616 and Shukh with a NiFeCr composition as taught by Mao in order to promote the texture and enhance the grain growth of the free layer or pinning layer consequently grown on top of the seed layer [Mao; col. 1, lines 55-61].
>
> Additionally, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation and optimization in the absence of criticality. In re Swain et al., 33 CCPA (Patents) 1250, 156 F2d 239, 70 USPQ 412; Minnesota Mining and Mfg. Co. v. Coe, 69 App. D.C. 217, 99 F2d 986, 38 USPQ 213; Allen et al. v. Coe, 77 App. D.C. 324, 135 F2d 11, 57 USPQ 136."

Responsive hereto, Applicant notes that the rejected claims 4-6, 20-22 and 33-35 are all dependent claims. Applicant respectfully submits that these claims are all allowable in that they depend, either directly or indirectly from an allowable base claim.

In paragraph 5 of the Office Action claims 27-29 and 40-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (hereinafter Gill '616) (US 6,674,616 B2) and Shukh et al. (hereinafter Shukh) (US 6,667,616 B1) as applied to claims 23 and 36 above, and further in view of Mao et al. (hereinafter Mao) (US 6,490,140 B1), stating:

> "Regarding claims 27-29 and 40-42, Gill '616 and Shukh teach all the features, supra, but do not show the composition of the NiFeCr layer as $Ni_{49.5}$ $Fe_{12.5}$ Cr_{38}

> Mao teaches the composition of seed layer [12] is preferably in the range of Ni_{60} $Fe_{15.5}$ Cr_{25} to about Ni_{48} Fe_{12} Cr_{40} [col. 4, lines 30-37], which encompasses the claimed range.
>
> It would have been obvious to one of ordinary skill in the art at the time the invention was made to manufacture the NiFeCr layer of Gill '616 and Shukh with a NiFeCr composition as taught by Mao.
>
> The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to manufacture the NiFeCr layer of Gill '616 and Shukh with a NiFeCr composition as taught by Mao in order to promote the texture and enhance the grain growth of the free layer or pinning layer consequently grown on top of the seed layer [Mao, col. 1, lines 55-61].
>
> Additionally, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation and optimization in the absence of criticality. In re Swain et al., 33 CCPA (Patents) 1250, 156 F2d 239, 70 USPQ 412; Minnesota Mining and Mfg. Co. v. Coe, 69 App. D.C. 217, 99 F2d 986, 38 USPQ 213; Allen et al. v. Coe, 77 App. D.C. 324, 135 F2d 11, 57 USPQ 136."

Responsive hereto, Applicant notes that the rejected claims 27-29 and 40-42 are all dependent claims. Applicant respectfully submits that these claims are all allowable in that they depend, either directly or indirectly from an allowable base claim.

Having responded to all of the paragraphs of the Office Action, and having amended the claims accordingly, Applicant respectfully submits that the Application is now in condition for allowance. Applicant therefore respectfully requests that a Notice of Allowance be forthcoming

at the Examiner's earliest opportunity. Should the Examiner have any questions or comments with regard to this amendment, a telephonic conference at the number set forth below is respectfully requested.

Respectfully submitted,

Dated: August 17, 2005

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